SELECTED ABSTRACTS OF PAPERS AT THE PAN-AMERICAN CONGRESS.

NATIONAL METEOROLOGICAL INSTITUTE OF URUGUAY.

By HAMLET BAZZANO.

[Author's abstract.]

The author begins with a description of the work carried on in the meteorological section of the institute and of the instruments of the section employed in the study of atmospheric electricity, of clouds, of telluric currents and their physical laws, of temperature and gravity, as well as the careful study of winds, which is a meteorologic factor of the greatest importance for the study of the estuary of the Plata River.

Incidentally he refers to the propaganda carried on by the institute for the purpose of eliminating the general tendency to make use of averages exclusively, analyzing the remote influences and anomalies in the course of the curves of the registers.

Then he analyzes the great differences between the meteorologic conditions of different points in the country and describes the work of the institute in the determination of the meteorologic data referred to and of the salinity, temperature, and other characteristics of the waters of the Plata, a study which has served for determining the propagation in various conditions of the tidal wave from the Atlantic.

He refers to the work undertaken some years ago by the institute of fixing the relation between certain classes of crimes and the state of the atmosphere, noting as a result of this work a parallelism between the increase of temperature and humidity and of the delinquencies in Montevideo. The results of five or six more years of observations are being awaited before attempting to draw conclusions on this subject.

The work done by the central observatory of the institute in the making of a weather map is then briefly described. Argentina, Brazil, and Uruguay and other countries of the southern part of the continent contribute to this work.

The work done by the section of the official time is also described. This section has charge of the transmission of the time to mariners, to the city three times a day, and to different points of the city where there are electric clocks, and the setting and regulating of chronometers and of clocks, especially those used in navigation.

The paper concludes with a description of the work done by the semaphoric service recently annexed to the National Meteorological Institute.

SNOW SURVEYING: ITS PROBLEMS AND THEIR SOLUTION.

By J. E. CHURCH, Jr.

[Author's abstract.]

The problem of precipitation and run-off has become the dominant meteorological problem in the semiarid States where irrigation is fundamental to agriculture.

Most of the requisite precipitation falls in the form of snow upon the higher mountains, where it is conserved until summer. The estimate of this precipitation and the amount of water available from it is complicated by the fact that for Nevada and probably other States reservoirs impound only 5 per cent of the water used in irrigation.

Apparatus.—Since the precipitation in this region is limited and must be used to the best advantage, the seasonal forecast should be based upon the most accurate methods compatible with the service rendered. Estimates of available water should preferably be based upon surveys of the snow fields themselves.

The seasonal snow gage is unsatisfactory, because of the strong wind currents, the great depth of snow, local divergencies in precipitation, probable freezing of the contents, and consequent difficulty in measuring the water content in March or April, when seasonal estimates should be made. A gage heated by acetylene gas would be expensive, and the cost of a number of seasonal gages of any type would be prohibitive.

Snow stakes in ordinary numbers are also unsatisfactory, except in forested regions or pockets of the mountains where the snow fields are protected from erosion and shifting by the wind. It is also questionable whether stakes of sufficient strength and height and in requisite numbers can be erected at reasonable expense.

Snow stakes, moreover, afford no clue to the exact water content of snow. However, the analysis of 1,900 measurements of the depth and water content of the snow on exposed mountain peaks has resulted in a table of relative density based on season and depth from which the water content of wind-driven snow can be approximately determined by an ordinary rod, if used along definite courses. It is hoped that the analysis of several thousand measurements already made at lower elevations in the forests will result in a similar table for snow laid under more tranquil conditions.

The snow sampler in its most highly developed form solves the difficulties confronting the seasonal gage and the snow stakes and can be operated anywhere that two men on snowshoes can go.

Methods.—The unit in snow surveying should be conducted to determine local divergencies in precipitation. This is especially necessary where the seasonal estimate is based upon the snow cover of the total watershed rather than upon the percentage relationship of the snow cover in characteristic parts of the basin to the corresponding snow cover of some season or series of seasons whose run-off is known.

The courses should be long and exactly marked, and measurements should be made at definite intervals. Where possible, level ground should be selected in order to obtain a mean between the overloaded northern slopes and the thinly covered southern ones.

The method of percentage relationship is probably simplest, and estimates have been accurate within 12½ per cent.

By careful surveys in one basin it is possible to forecast for the next adjoining basin as well.

TEMPERATURE CONDITIONS AT NEW ORLEANS AS INFLUENCED BY SUBSURFACE DRAINAGE.

By ISAAC M. CLINE.

[Author's abstract.]

The frequent occurrence of high temperatures at New Orleans in recent years, which general meteorological conditions did not account for, indicated that some local influences are responsible for their occurrence.

New Orleans is situated near the center of the great Mississippi Delta. The elevation of a large part of the city is not much above sea level, and the ground water under ordinary conditions was level with the surface of the ground. Storm water and water from other sources was carried away in a sluggish manner over the surface. Much of the country surrounding New Orleans was covered the greater part of the time with water from the Gulf of Mexico. These conditions exerted a material influence on temperature conditions, giving a climate insular in many respects.

Natural physical conditions as they existed were not conducive to healthfulness and the water formed breeding places for disease-carrying mosquitoes and other pests. To relieve this condition, subsurface drainage was put into operation in 1900, and a sewerage system to carry off sewage water was installed in 1903. The operation of these drainage systems has carried off the surface water rapidly and lowered the level of the ground water 6 to 8 feet below the surface of the ground. Large areas around New Orleans have been drained, so that ground which was formerly marsh or with the ground-water level with the surface of the land is now under ordinary conditions dry ground.

The effects of these artificial changes in physical condition on solar and terrestrial radiation have materially affected temperature conditions. Prior to 1900 the temperature at New Orleans had never reached 100°F., but since that year temperatures of 100°, or above, have been recorded seven times. During the 15 years prior to the installation of subsurface drainage in 1900, temperatures of 95°, or above, were recorded on 35 days, while during the 15 years 1900 to 1914, inclusive, the period during which subsurface drainage has been in operation, temperatures of 95°, or above, have been recorded on 74 days, an increase of 122 per cent over that of the period just prior to the installation of subsurface drainage. Other temperatures have also been materially influenced by the artificial changes in physical conditions.

The summer of 1915, which is not included in the two periods compared, had 25 days with the temperature 95°, or above, only 10 days less than the total number in the 15 years ending with 1899, just preceding the installation of subsurface drainage. The precipitation during the summer of 1915 was above the normal, but the number of rainy days was only about half the average. There were periods of 6 to 8 days in succession without rain, which gave the changes made in physical conditions an opportunity to show their influences. Similar periods without precipitation prior to subsurface drainage, even in months when the amounts were below the normal, did not give high temperatures comparable with those of 1915 either as regards frequency or intensity.

FOG FORECASTING IN THE UNITED STATES.[1]

By H. C. FRANKENFIELD.

[Author's abstract.]

Fog, definition of.—A surface cloud caused (1) by the mixing of two bodies of air of unequal temperature, one or both of which has a high vapor content, and (2) by the cooling of a body of moist, free air to a temperature lower than its dew point.

Scope of paper.—To consider the character, extent, etc., of the physical causes of fog, with a view to forecasting the approach of dense fog on the great navigable waters within or immediately adjacent to the United States, viz, coasts of the Great Lakes, the Atlantic, and the Gulf of Mexico.

[1] The full text of this paper will appear in the manual on forecasting, in preparation by the U. S. Weather Bureau.—C. A., Jr.

LAKE REGION.

Seasonal distribution of fog.—February is the month of greatest fog frequency on the lakes, and July and August the months of least frequency, with more marked seasonal characteristics and greater frequency over the southern portion of the district.

Conditions favorable for fog formation.—(1) Low pressure on the leeward side of the lakes and relatively high pressure on the windward side, with a weak gradient (0.10 inch in 100 to 250 miles). (2) Temperature differences more or less marked between the water and land surfaces. In about two-thirds of the cases the water temperature was the lower. (3) Relative humidity above normal, averaging above 90 per cent. (4) The occurrence of precipitation from 24 to 36 hours previous to the fog, usually to the westward and southward of the lakes. (5) Low wind velocities, less than 15 miles an hour (less than 6 miles above one-third of the time).

Region of maximum frequency.—From the southern third of Lake Michigan eastward over extreme southern Lake Huron to western Lake Erie.

Form of fog covering.—Usually uniform like a blanket, but quite frequently in banks, or bands, both along shore and over the water. The blanket form is most prevalent when the low-pressure systems are moving slowly toward the lakes.

ATLANTIC COAST.

Regions of maximum frequency (with diagram).—The region of greatest frequency is the eastern coast of Maine with a steady decrease to almost zero at Key West, Fla., with a few explainable exceptions.

(1) Fogs are most frequent where the water temperatures are lowest.

(2) Fog frequency in any given locality is proportional to the differences in temperature between the land and water surfaces.

Geographic distribution of fog.—This is almost entirely a question of pressure distribution and resulting wind direction. Fog occurs at times along the entire coast from Eastport, Me., to Jacksonville, Fla., and from thence westward along the Gulf coast to the mouth of the Rio Grande; at other times from the Maine coast to Hatteras, N. C., to Cape May, N. J., to New York, etc. Another fog type extends along the ocean from northeast to southwest, touching the coast at only a few points, such as Nantucket, Mass., and Hatteras, N. C.

Seasonal distribution (with table).—Fog is most frequent in midsummer on the New England coast, and least frequent in winter; most frequent in winter and early spring on the Middle and South Atlantic coasts, and least frequent in midsummer.

GULF OF MEXICO.

The same general rules apply to Gulf of Mexico fogs as to those of the Lakes and the Atlantic coast. The region of maximum frequency occurs between the northwest coast of Florida and the northeast coast of Texas, the number of foggy days increasing from east to west. (Diagram and table.)

The season of greatest frequency is winter, and that of least frequency summer, fog being very rare in the latter season owing to the high temperatures and the high vapor content of the air.

GENERAL NOTES.

(1) Fog belts appear to "travel," generally from west to east, but occasionally in the opposite direction.

(2) A good fog type for the South Atlantic and Gulf coasts is high pressure over Bermuda and low pressure over Texas and Oklahoma, with a very weak gradient.

(3) Fogs form frequently on the Atlantic coast with low pressure north of Lake Superior, moving northeastward.

(4) The fog belt is not always continuous along a coast.

SLEET AND ICE STORMS IN THE UNITED STATES.

By H. C. FRANKENFIELD.

[Author's abstract.]

Definition of terms.—Sleet is precipitation that occurs in the form of frozen, or partly frozen, rain, and is formed by rain falling from a relatively warm air stratum into and through another air stratum that is sufficiently cold to freeze some or all of the rain drops. Mixtures of snow and rain are not sleet; neither are mixtures of hail and rain. A modification of sleet, but not true sleet, is rain that actually falls to the surface as rain, but freezes as soon as it touches the surface. This is the form that causes the greatest damage.

The etymology of the term is uncertain. Some of the earlier equivalents are the Middle High German "Sloze," the German "Schlosse," and the Norwegian "sletta," the latter meaning to "slap." Sleet and hail are different, both formatively and structurally.

Geographical distribution.—Sleet storms are very rare west of the Rocky Mountains and along the eastern slope of the mountains. The region of greatest frequency is over the great interior valleys, and from thence eastward, that is, over the section traversed by the principal low pressure systems. (See diagram.)

Seasonal distribution.—The months of greatest sleet frequency are January and February over the Great Valleys, the Lower Lakes, and the Middle Atlantic States, and March and December over the Upper Lakes. The Upper Lake storms are rarely so severe as the others. Sleet has been observed as late as May and as early as October 3.

Conditions favorable for sleet and ice storms.—(1) Low pressure and high temperature to the northward; 72 per cent well developed and 28 per cent fairly so; no failures.

(2) Steep pressure and temperature gradients to the northward; 69 per cent well developed and 12 per cent fairly so; 19 per cent failed.

(3) Surface temperatures below the freezing point, usually between 22°F. and 28°F.

(4) Moderately high pressure and high temperature over the East Gulf and South Atlantic States. This occurred in 70 per cent and failed in 30 per cent of the cases.

(5) Northward looping of the isotherms (surface inversion). True in 88 per cent of the cases.

(6) Gentle to fresh northerly winds, increasing by the time sleet begins. Almost uniformly true.

(7) Low pressure trough between two highs, trending from southwest toward northeast. Low center, usually moving from southwest.

Sleet or snow, which?—(1) The steep temperature gradients to the northward of the storm center that precedes sleet are not necessarily in advance of heavy snow.

(2) The high temperatures over the Gulf and South Atlantic States necessary to sleet formation are absent before and during heavy snows.

(3) The warm southerly winds over the Gulf and South Atlantic States come from warm water surfaces, and carry a much larger water-content than winds from any other directions. Out of 34 cases of sleet, 29 were preceded by warm southerly winds over the South Atlantic and East Gulf States, while out of 48 cases of heavy snows, 28 were preceded by cool weather over the South and only 5 by warm weather.

CLIMATIC FLUCTUATIONS DURING THE HISTORIC EPOCH.

By ANTONIO GALÁN, S. J.

[Author's abstract.]

The investigations which Dr. Ellsworth Huntington, professor at Yale University, has made in the ruins which are found in an extensive area in southern Arizona, New Mexico, Yucatan, and Guatemala have cleared up in a great measure the difficult problem of the climatological fluctuations in historic times.

From these investigations the deduction is made that numerous tribes inhabited these regions, engaging principally in agriculture, while at the present time the cultivation of the soil is impossible.

A study of the terraces of America and their comparison with the investigations of Penck in Asia leads to the same conclusion.

Finally, the method of investigation introduced by Dr. Andrew E. Douglass, professor of the University of Arizona, in the study of the development of the pines of Arizona and New Mexico, and applied by Dr. Huntington to the sequoias of California, is still another argument in favor of this hypothesis. The curves which represent the annual development of these trees in periods of from 300 to 500 years present notable variations. These variations appear to be due to climatic fluctuations, since the annual development of trees is determined by their alimentation, and this depends in great part upon the amount of rainfall.

If this is true, the investigations made of the development of trees will indicate not only that there existed notable climatic variations in historic times but also that these variations were in the nature of pulsations.

All this leads to the belief that the cause of these fluctuations must be sought in the displacement of the great climatic zones of the earth. In historic times climatic variations were probably of the same character as those of the glacial period. Regions which are passing through a similar period are those of permanent high pressure. According to this a part of the United States might be under the influence of an area of high pressure during the whole year. The storms which to-day cross from the Pacific to the Atlantic, providing the greater part of the precipitation in the regions which they cross, would be obliged to move southward, thus supplying an abundant rainfall for the arid regions of the Southwest.

Investigations which have been made of the ruins found in the forests of Yucatan and adjacent regions indicate that the climate there was drier, more varied, and less enervating than at present. This confirms the above ideas; for if the storms of the West were pushed toward the South it might result that regions like Yucatan would have the varied climate which characterizes the central part of the United States. The trade winds would be destroyed or pushed toward the south, causing abundant and continuous rains, thus prolonging the dry season and making the climate fresher and more varied.